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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : E04B 5/40

A1

(11) International Publication Number: WO 96/21069

(43) International Publication Date: 11 July 1996 (11.07.96)

(21) International Application Number: PCT/AU96/00006

(22) International Filing Date: 5 January 1996 (05.01.96)

(30) Priority Data:
PN 0395 6 January 1995 (06.01.95) AU

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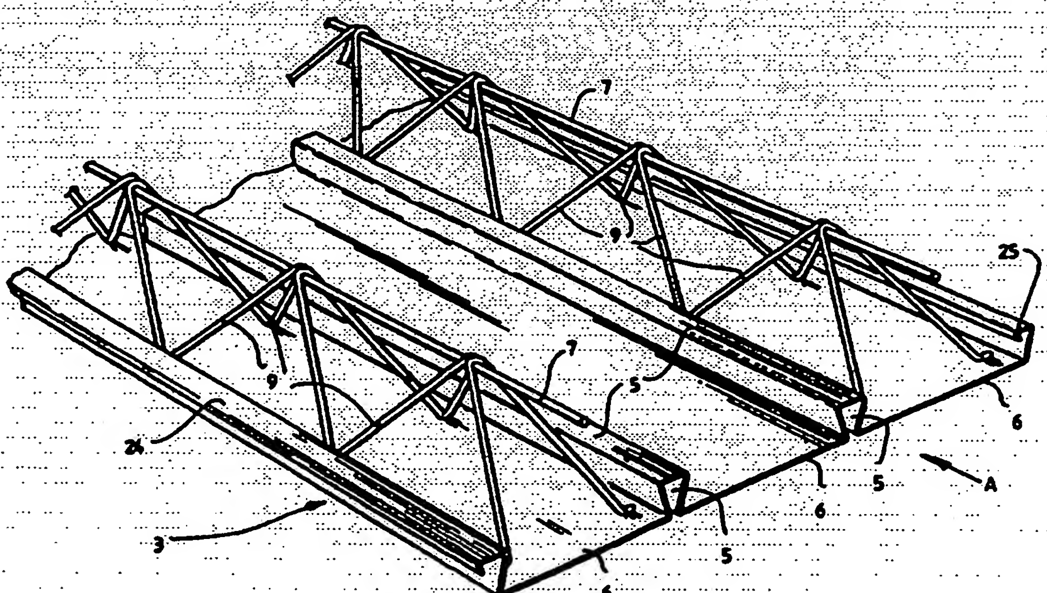
(81) Designated States: AL, AM, AT, AU, AZ, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, EE, ES, FI, GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO patent (KE, LS, MW, SD, SZ, UG), Eurasian patent (AZ, BY, KZ, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: A STRUCTURAL MEMBER



(57) Abstract

A structural member for use in the construction of composite slabs for flooring systems of buildings is disclosed. The structural member comprises: (a) a profiled steel sheeting (3) having a plurality of parallel ribs (5) separated by pans (6); (B) a plurality of top chord elements (7) spaced above the steel sheeting (3); and (c) a plurality of web chord elements (9) connecting together the steel sheeting (3) and the top chord elements (7) with each web chord element (9) being connected to one of the pans (6) or to adjacent pans (6); such that the steel sheeting (3), the top chord elements (7), and the web chord elements (9) define at least one truss.

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A STRUCTURAL MEMBER

The present invention relates to a structural member.

The present invention relates particularly although by no means exclusively, to a structural formwork for use in the construction of composite slabs for flooring systems of buildings.

It is known to use profiled steel sheeting having parallel ribs separated by pans as a structural formwork in the construction of flooring systems of buildings. In use, profiled steel sheeting is welded or otherwise secured to horizontal supports, reinforcing mesh is positioned on the sheeting, and concrete is then poured in situ to complete construction of composite slabs.

However, profiled steel sheeting can only be used in relatively short spans (typically less than 2,500mm)

between permanent supports before requiring temporary propping during construction and while the concrete cures. In addition, profiled steel sheeting lacks the stiffness and strength offered by many competing types of conventional timber and precast concrete formwork. These factors affect the capacity of the formwork to carry construction loads, such as stacked materials.

In particular, in steel-framed buildings where unpropped construction is often favoured, the relatively poor spanning capability of profiled steel sheeting has significantly restricted the range of floor framing arrangements that can be considered in design. This has impinged on the economy of steel-framed buildings and made it more difficult for steel-framed buildings to be competitive with concrete-framed buildings.

It is also known to use precast concrete panels as a structural formwork in the construction of flooring systems of buildings.

A known type of precast concrete formwork comprises precast concrete panels incorporating "Pittini" reinforcing trusses (also known as "lattice girders") embedded in the concrete. The trusses comprise parallel top and bottom chord elements that are connected together by web chord elements. In use, the panels are placed directly on horizontal supports or bedded on concrete mortar where there are irregularities. After the panels are positioned, concrete is poured in situ to complete construction of composite slabs. In Australia, this form of construction is known as the TRANSFLOOR system.

The pre-cast concrete panels of the TRANSFLOOR system typically weigh 140 kg/m^2 (55 mm deep) and are 2,500mm wide, and the recommended maximum truss spacing is 500 mm for slab panels. The panels are relatively heavy

(compared with profiled steel sheeting) and must be lifted by crane into position.

The TRANSFLOOR pre-cast panels are typically propped at 2,400 and 1,800 mm centres for forming slabs and beams, respectively, to suit the spacing of standard steel frames used as falsework. For spans in excess of 3,000 mm, it is required to specifically check that deflections are satisfactory.

The TRANSFLOOR pre-cast panels may be cast with polystyrene void formers placed between the trusses to reduce the volume and weight of the concrete poured on top of the panels to form the finished composite slab.

The TRANSFLOOR pre-cast panels have greater stiffness and strength than profiled steel sheeting.

However, the TRANSFLOOR pre-cast panels are significantly heavier and are more easily damaged than profiled steel sheeting. Thus, considerably more care must be taken when transporting and handling the TRANSFLOOR pre-cast panels.

It is also known from Japanese patent application JP, A, 4-222739 (Hory Corp) to use a profiled steel sheeting with top chord elements spaced above the sheeting and web chord elements welded to the top chord elements and to the steel sheeting as a structural formwork in the construction of flooring systems for buildings. In this arrangement, the steel sheeting, the top chord elements and the web chord elements define trusses. The Japanese patent application teaches that the web chord elements should be welded to the tops of the ribs of the steel sheeting and does not disclose or suggest the connection of the web chord elements to any other location or part of the steel sheeting.

The applicant has carried out finite element modelling and analysis work on the structural formwork disclosed in the Japanese patent application and a range of possible alternative constructions and has found that an arrangement in which the web chord elements are connected to the pans and not to the ribs of the steel sheeting has comparable and, in some instances, significantly better performance.

As a consequence, according to the present invention there is provided a structural member comprising:

(a) a profiled steel sheeting having a plurality of parallel ribs separated by pans;

(b) a plurality of top chord elements spaced above the steel sheeting; and

(c) a plurality of web chord elements connecting together the steel sheeting and the top chord elements with each web chord element being connected to one of the pans or to adjacent pans;

such that the steel sheeting, the top chord elements, and the web chord elements define at least one truss.

It is preferred that the web chord elements that are connected to one top chord element be connected to one pan such that the top chord element is positioned above that pan.

In an alternative arrangement it is preferred that the web chord elements that are connected to one top chord element be connected to adjacent pans such that the top chord element is positioned above the rib that

separates the adjacent pans.

It is preferred that the structural member be a structural formwork for use in the construction of a composite slab for a flooring system of a building.

It is preferred that the connections between the web chord elements and the steel sheeting and between the web chord elements and the top chord elements be capable of transferring longitudinal shear and tensile forces that develop when the structural formwork is loaded.

The steel sheeting may be any suitable profile. For example, the ribs may be open or closed, i.e. re-entrant.

It is preferred that the steel sheeting comprise two ribs that divide the steel sheeting into three pans and a lap joint that extends along each side edge of the steel sheeting.

The top chord elements may be of any suitable construction and configuration. For example, the top chord elements may be reinforcing bar or wire or elongated channel-shaped members.

Similarly, the web chord elements may be of any suitable construction and configuration.

The web chord elements may be connected to the steel sheeting and the top chord elements by any suitable means, such as welds, nails, clinch or screws.

According to the present invention there is also provided a composite slab for a flooring system of a building comprising:

(a) the structural formwork described in the preceding paragraphs; and

(b) a layer of concrete on the structural formwork.

The present invention is described further by way of example with reference to the accompanying drawings in which:

Figure 1 is a perspective view of a preferred embodiment of a structural formwork for use in constructing a composite slab for a flooring system of a building;

Figure 2 is an end view of the structural formwork in the direction of the arrow A in Figure 1;

Figures 3(a) and 3(b) are end views similar to Figure 2 of alternative forms of location and connection of elements of the structural formwork;

Figure 4 is an end view of a replica TRANSFLOOR pre-cast concrete formwork panel used in test work carried out by the applicant;

Figure 5 illustrates the test work set-up;

Figure 6 is a load-deflection curve obtained from the test work on the TRANSFLOOR pre-cast panel;

Figures 7(a) and 7(b) are load-deflection curves for structural formwork formed in accordance with the present invention tested by the applicant and using BONDEK profiled steel sheeting;

Figure 8 is a load-deflection curve for BONDEK profiled steel sheeting tested by the applicant and;

Figure 9 is a table of results of finite element analysis and modelling work carried out by the applicant.

The preferred embodiment of the structural member shown in Figures 1 and 2 is suitable for use as structural formwork for a composite slab for a flooring system of a building.

With reference to Figures 1 and 2, the structural formwork comprises:

(a) a profiled steel sheeting 3 having two parallel ribs 5, three pans 6, and two lap joints 24, with the ribs 5 and the lap joints 24 extending in the longitudinal direction of the profiled steel sheeting 3;

(b) two top chord elements 7 spaced above the steel sheeting 3 and extending parallel to the ribs 5; and

(c) a plurality of web chord elements 9 interconnecting the steel sheeting 3 and the top chord elements 7 to provide bracing in both the longitudinal and lateral directions of the profiled steel sheeting 3.

In effect, the formwork comprises trusses that are constructed with the profiled steel sheeting 3 forming the bottom chord element of each truss.

In accordance with the present invention, the web chord elements 9 are connected to the pans 6.

In this connection, in the embodiment shown in Figures 1 and 2, the top chord elements 7 are positioned

above the centre of the two outer pans 6 of the profiled steel sheeting 3 and the web chord elements 9 of each top chord element 7 are connected to the pan 6 above which the top chord element 7 is located. The centre pan 6 of the profiled steel sheeting 3 is free.

The present invention extends to any other suitable arrangement of the top chord elements 7, the web chord elements 9, and the profiled steel sheeting 3 in which the web chord elements 9 are connected to the pans 6. By way of example, in the embodiment shown in Figure 3(a) the top chord elements 7 are positioned above the ribs 5 and the web chord elements 9 of each top chord element 7 are connected to the pans 6 on opposite sides of the ribs 5 so that, in effect, the web chords 9 straddle the ribs 5.

The profiled steel sheeting 3 may be of any suitable configuration, such as BONDEK steel sheeting.

The top chord elements 7 and the web chord elements 9 shown in the figures comprise lengths of reinforcing bar. It is noted that the top chord elements and the web chord elements may be formed from any other suitable section and be of any suitable configuration.

In the arrangement shown in Figures 1 and 2, the web chord elements 9 are welded to the steel sheeting 3 and to the top chord elements 7. With reference to Figure 3(b), alternative forms of connection of the web chord elements 9 to the profiled steel sheeting 3 and to the top chord elements 7 comprise clinched or screwed connections.

It is noted that the present invention extends to any suitable form of connection of the web chord elements 9 to the profiled steel sheeting 3 and to the top chord elements 7 which is capable of transferring longitudinal shear and tensile forces that develop when the assembled

unit is loaded.

The structural formwork described above has the following features and advantages over other types of formwork such as profiled steel sheeting per se and precast concrete panels (such as TRANSFLOOR precast panels).

(i) By connecting the web chord elements 9 directly to the steel sheeting 3, the profiled steel sheeting 3 acts as the bottom chord of a plurality of trusses and its very large tensile capacity is available to be utilized in the longitudinal spanning direction of the formwork, thereby enabling relatively long unpropped span lengths.

(ii) The second moment of area of the profiled steel sheeting 3 about its horizontal major principal axis contributes to the stiffness of the formwork. This contribution would be particularly significant in shallow panels.

(iii) There is the potential to reduce the density of the trusses by leaving the central pan open as is shown in the embodiment of Figures 1 and 2. This applies because the ribs 6 can stiffen the profiled steel sheeting 3 to a significant degree. The resulting deflection of the profiled steel sheeting 3 in the unsupported pan 6 would therefore be less than if the sheeting 3 was flat. The option to leave free the middle pan 6 also makes it possible for the profiled steel sheeting 3 to be walked on and the weight kept more manageable during handling. It is also noted that by fitting polystyrene void formers in the free pans 6, workers find it easier to step over the trusses by walking on the polystyrene.

(iv) The use of profiled steel sheeting 3 (as opposed to flat steel sheeting) has another advantage in that the ribs 5 develop mechanical interlock with the concrete which contributes to the effectiveness of the sheeting acting as longitudinal reinforcement of the composite slab.

The structural formwork described above has the following features and advantages when compared with the arrangements disclosed in Japanese patent application JP, A, 4-222739.

(i) The applicant has found in finite element modelling and analysis work, which is discussed in more detail below, that the connection of the web chord elements 9 to the pans 6 in accordance with the present invention and not to the ribs as taught in the Japanese patent application produces structural formwork that has at least comparable, and in some situations significantly better, performance.

(ii) A particular feature of the present invention is that it is well-suited to BONDEK and similar profiled steel sheeting that has female lap ribs 24 and male lap ribs 25 along each side of the steel sheeting. When connected together on site, the female lap ribs 24 and male lap ribs 25 form lap joints 26. The reason for this is that more trusses can be positioned in the pans 6 for a given width than with the arrangements disclosed in the Japanese patent application because the Japanese trusses can not be connected to the male lap ribs 25.

(iii) The present invention is not subject to the limitation of the arrangements disclosed in the

Japanese patent application that the ribs must be open in order to enable the web chord elements to be welded to the ribs.

(iv) The present invention is not subject to the limitation of the arrangements disclosed in the Japanese patent application that the width of the "trusses" is determined by the spacing of the ribs of the profiled steel sheeting.

In order to evaluate the performance of the structural formwork of the present invention the applicant carried out the following experimental work.

1. Test work on the following types of formwork:

(a) a TRANSFLOOR pre-cast panel;

(b) a preferred embodiment of the structural formwork of the present invention; and

(c) BONDEK steel sheeting.

2. Finite element modelling and analysis work to compare the performance of the structural formwork of the present invention with that disclosed in Japanese patent application JP, A, 4-222739.

1(a) TRANSFLOOR pre-cast panel.

The TRANSFLOOR pre-cast panel was constructed according to the details shown in Figure 4 and comprised a plurality of "Pittini" trusses 15 embedded in concrete. The panel was 3,200 mm long and weighed 2.47 kN.

The test set-up is shown in Figure 5. The

TRANSFLOOR panel was supported at its end so that the unsupported span length was 3,000 mm and the loads were applied to the top face of the concrete at four locations along its length and across its width. The loading points coincided with open areas between the panel points of the "Pittini" trusses 15 to enable steel bearing plates to be positioned through the openings. Therefore, the loading points were not at the normal (L/8, 3GL/4, L/8) locations suited to simulating bending under uniform loading (see Figure 6). The load was applied at a uniform displacement rate in deflection control.

The total load-deflection curve obtained from the test is shown in Figure 6, and is briefly described as follows.

The initial portion of the curve (shown dashed) had to be estimated from the self weight of the panel (≈2.3 kN between support lines) using the average stiffness calculated while the loading frame was being applied (i.e. the next stage of loading) and taking into account the final loading pattern.

At a total load of approximately 6.8 kN, the slope of the load-deflection curve reduced suddenly corresponding to the onset of cracking of the concrete. Throughout the test, the cracks were observed to coincide with the lower node points of the "Pittini" trusses 15 where the truss webs provided anchorage to the bottom chord wires, noting that at higher loads the cracks extended over the full depth of the concrete indicating that at the cracks the tensile reinforcement carried the whole of the tensile forces. It can be seen in Figure 6 that the slope of the curve prior to cracking is satisfactorily predicted using elastic "uncracked" transformed section theory as recommended in the TRANSFLOOR Technical Manual. Using this theory, the tensile stress in the bottom fibre of the

concrete reached approximately 4 MPa at the onset of cracking. The compressive strength of the concrete at the time of loading was 31.0 MPa, and this value is very close to the characteristic strength of the N32 concrete specified for TRANSFLOOR panels.

However, once cracking began, the flexural stiffness of the TRANSFLOOR panel reduced considerably as shown in Figure 6.

The TRANSFLOOR panel finally failed at mid-span when the two top chords of the "Pittini" trusses 15 buckled together in compression. The failure occurred suddenly when the total load was approximately 15.9 kN (with a corresponding applied load equal to 13.5 kN). At this stage, the maximum bending moment (per "Pittini" truss 15) supported at the mid-span cross-section was 3.0 kNm. This compared with an allowable moment capacity of 1.52 kNm for a T110 truss given in the Transfloor Technical Manual. Assuming a lever arm of 107 mm between the centres of the top and bottom chords (which was a measured value), the stress in the 10mm diameter top chords of the "Pittini" trusses 15 reached a maximum value of 357 MPa. With knowledge of the stress-strain properties of the top chord steel, it was possible to deduce that the steel was still behaving elastically immediately prior to buckling.

1(b) Preferred embodiment of the present invention.

The preferred embodiment of the structural formwork of the present invention was constructed using a sheet of 1.00 mm BONDEK profiled steel sheeting and two of the same "Pittini" trusses used to construct the TRANSFLOOR panel described above. Therefore, the panel was fabricated slightly differently to that shown in Figure 2. The small bottom wires of the "Pittini" trusses were spot-resistance welded to the BONDEK sheeting in the middle between each

truss panel point. Tensile testing of welded samples was carried out to confirm the suitability of the welding process once the machine settings had been determined. It should be noted that the tensile capacity of these bottom wires was very small compared with that of the BONDEK sheeting.

The test specimen weighed only 0.36 kN (compared with the TRANSFLOOR panel which weighed 2.47 kN).

The test work set-up was the same as that shown in Figure 5 for the TRANSFLOOR panel. The panel spanned simply-supported for 3000 mm, and the loads were applied at the same four locations along its length as for the TRANSFLOOR panel. In one test (Test 1) on the panel, the loads were applied in the middle pan alone (see Figure 7(a)). This test was terminated before causing any permanent damage to the specimen. The panel was then tested to failure (Test 2) with the loads only applied in the outer pans where the "Pittini" trusses were located.

The total load-deflection curves for Tests 1 and 2 are shown in Figure 7, and are briefly described as follows.

During Test 1, the middle pan deflected much more than the outer pans which were restrained by the "Pittini" trusses (see Figure 7(a)). This was quite a severe test on the strength of the welds connecting the trusses to the sheeting. No welds failed and there were no other undesirable secondary effects. Therefore, the test proved the robustness of the system to support reasonably heavy concentrated loads. The response up to a comparatively high load approaching 9 kN was entirely linear, and the specimen returned to its original position when the load was removed. In actual construction, once the concrete has been poured, the weight of the concrete will be uniformly

distributed across all the pan areas, and the differential deflection between adjacent pans (eg line 2 less line 1) should be considerably less for this situation than shown in Figure 7(a).

During Test 2, all the pans deflected about the same amount and only the average response is plotted in Figure 7(a). It can be observed that the curve is very linear. The test specimen was slightly more flexible than expected, which was most likely due to the free male and female lap ribs at the edges of the specimen which tended to deflect laterally while being loaded. If multiple panels had been tested joined together, it is likely that the discrepancy would have been less.

The entire total load-deflection curve for the test specimen when it was tested to failure is shown in Figure 7(b). It can be observed that the response is very linear right up until the point of collapse when one of the top-chord elements buckled in compression. The test specimen collapsed at a total load of 24.63 kN, corresponding to an applied load of 24.27 kN.

1(c) BONDEK steel sheeting.

A length of 1.00 mm Bondek sheeting used to construct the preferred embodiment of the structural formwork of the present invention discussed in section (b) above was tested to failure in an identical manner as the preferred embodiment.

The associated total load-defection curve is shown in Figure 8. The total load-deflection curve of the preferred embodiment of the present invention is included in Figure 8 to show the dramatic difference in performance between the two products, both with regard to flexural stiffness and strength. With reference to Figure 8, the

preferred embodiment was about five times as stiff and about 1.65 times as strong.

The BONDEK steel sheeting specimen failed normally by buckling of the ribs within the mid-span region. As noted above, the preferred embodiment also failed by buckling (also in the mid-span region) when the reinforcing bars forming the top chords of the "Pittini" trusses gave way in compression. At the point of failure, both specimens exhibited a sudden reduction in strength, which under dead (conservative) loading would result in sudden collapse. This type of behaviour is considered to be satisfactory.

The test work confirmed that BONDEK profiled steel sheeting could only be used in relatively short spans between permanent supports before requiring temporary propping. In reality it also lacks the stiffness and strength offered by many competing types of conventional timber and precast-concrete formwork systems.

The test work also established that the preferred embodiment of the present invention had significantly improved structural performance over the BONDEK steel sheeting. For example, the test work showed that by fitting two 110 mm high "Pittini" trusses with only 10 mm diameter top-chord wires to two pans of a 1.00 mm BONDEK sheeting, that it became about five times as stiff (which remained constant until failure) and 1.65 times as strong.

Furthermore, the results of a parametric study carried out by the applicant showed that for slab depths up to 200 mm and a deflection limit of span/240 (normally associated with tight deflection control for visible soffits), it is likely that unpropped spans in excess of 5000 mm can be achieved using two 150 mm high "Pittini" trusses per sheet with 24 mm diameter bars. By relaxing

the deflection limit to span/150, it is predicted that the same BONDEK sheeting "Pittini" truss panels of the present invention could span in excess of 6000 mm. Further improvements could be made by voiding the slabs, and it is feasible that the performance of the present invention as formwork could then begin to match that of precast, hollow-core slabs.

The test work also showed that a typical precast-concrete truss panel (viz. the TRANSFLOOR panel), which was approximately seven times the weight of the preferred embodiment of the present invention, had very inferior performance and rapidly lost it flexural stiffness at the onset of cracking.

2. Finite element modelling and analysis.

The modelling work was carried out with ABAQUS Version 5.4-1 and the analysis work was carried out with IDEAS.

The purpose of the finite element modelling and analysis work was to assess the performance of a range of different structural formwork configurations under uniform load conditions that would result from wet concrete being cast onto each formwork to a depth of 170mm.

The left-hand column of Figure 9 includes a transverse section of each structural formwork evaluated by the applicant.

With reference to the Figure, the formwork ranged from:

(i) a flat steel sheet with two lines of trusses connected to the sheet (sample(a)),

(ii) a profiled steel sheet with two parallel lines of trusses connected to the ribs (sample(e)) in accordance with the teaching of the Japanese patent application, and

(iii) various embodiments of the present invention (samples (c), (d), (f), (g) and (h)).

For the purpose of the finite element modelling and analysis work, the applicant selected:

(i) a width of 600mm for the steel sheeting for all samples except for sample (a) (300mm wide);

(ii) a spacing of 200mm between the trusses for samples (a) and (g), 400mm between the trusses of samples (b) to (f), and 240mm between the trusses of sample (h), in each case measured from top chord to top chord;

(iii) an initial height of 110mm for each sample - as measured between the centres of the top chords and the pans; and

(iv) span lengths of 2m and 4m for all samples with the samples simply-supported at each end, and a span length of 4m for samples (d) to (f) with the samples fixed at each end.

The modelling and analysis work predicted the average maximum vertical defection (in mm) of the pans, the ribs, and the top chords at transverse sections through the formwork midway between the formwork supports.

From the viewpoint of performance, the important

parameters are:

(i) the top chord deflection; and

(ii) the differential local deflection, i.e. pan deflection - top chord deflection.

The results in Figure 9 establish that the overall performance of samples (c), (d), (f) and (g) in accordance with the present invention is at least comparable to that of sample (e) in accordance with the Japanese patent application. The results also establish that the top chord deflection of samples (c), (d), (f), and (g) was considerably less than that for sample (e) and, therefore the samples in accordance with the present invention performed significantly better than that of the Japanese patent application in terms of this parameter. The results also establish that the present invention allows substantial flexibility in terms of positioning of the trusses without loss of performance.

Since modifications within the spirit and scope of the invention may readily be effected by persons skilled in the art, it is to be understood that this invention is not limited to the particular embodiment described by way of example hereinabove.

CLAIMS:

1. A structural member comprises:

(a) a profiled steel sheeting having a plurality of parallel ribs separated by pans;

(b) a plurality of top chord elements spaced above the steel sheeting; and

(c) a plurality of web chord elements connecting together the steel sheeting and the top chord elements with each web chord element being connected to one of the pans or to adjacent pans;

such that the steel sheeting, the top chord elements, and the web chord elements define at least one truss.

2. The structural member defined in claim 1 wherein the web chord elements that are connected to one top chord element are connected to one pan such that the top chord element is positioned above that pan.

3. The structural member defined in claim 1 wherein the web chord elements that are connected to one top chord element are connected to adjacent pans such that the top chord element is positioned above the rib that separates the adjacent pans.

4. The structural member defined in any one of the preceding claims wherein the connections between the web chord elements and the steel sheeting and between the web chord elements and the top chord elements are capable of transferring longitudinal shear and tensile forces that develop when the structural formwork is loaded.

5. The structural member defined in any one of the preceding claims wherein the ribs are open or closed.

6. The structural member defined in any one of the preceding claims wherein the steel sheeting comprises two ribs that divide the steel sheeting into three pans and a lap joint that extends along each side edge of the steel sheeting.

7. The structural member defined in any one of the preceding claims wherein the top chord elements are selected from reinforcing bar or wire or elongated channel-shaped members.

8. The structural member defined in any one of the preceding claims wherein the web chord elements are selected from reinforcing bar or wire or elongated channel-shaped members.

9. A composite slab for a flooring system of a building comprises:

(a) the structural formwork defined in any one of the preceding claims; and

(b) a layer of concrete on the structural formwork.

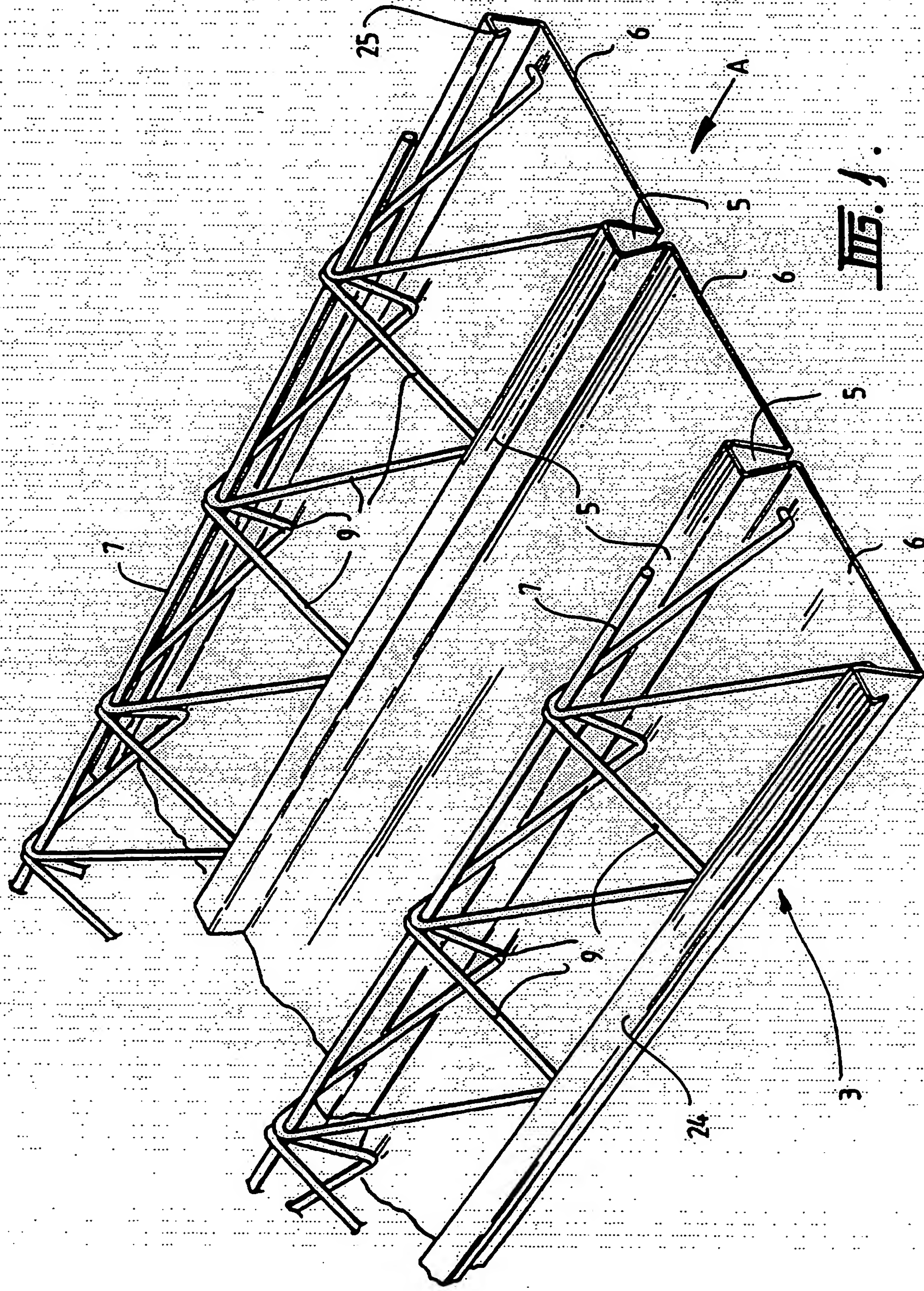


FIG. 1.

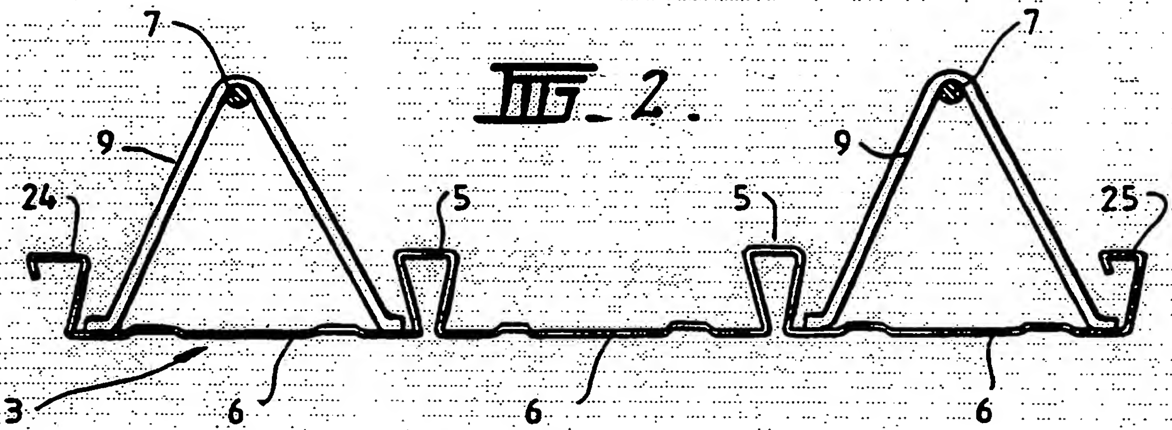


FIG. 2.

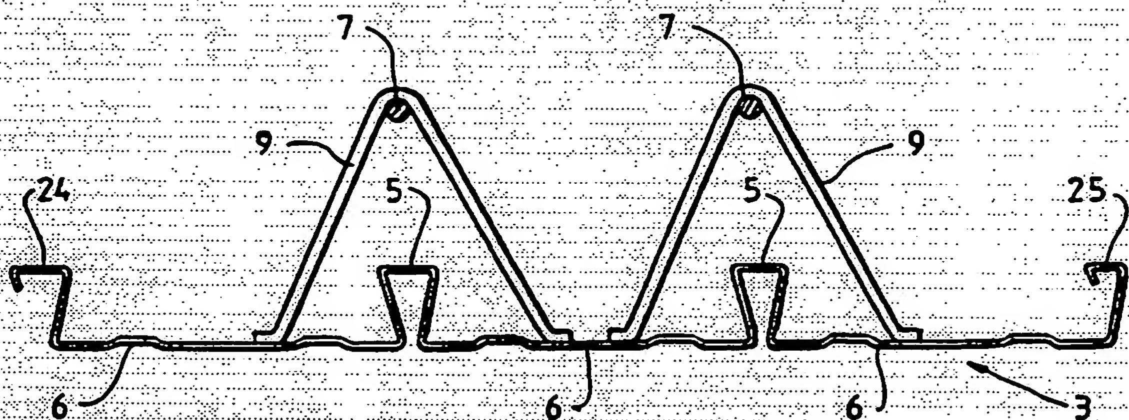


FIG. 3a.

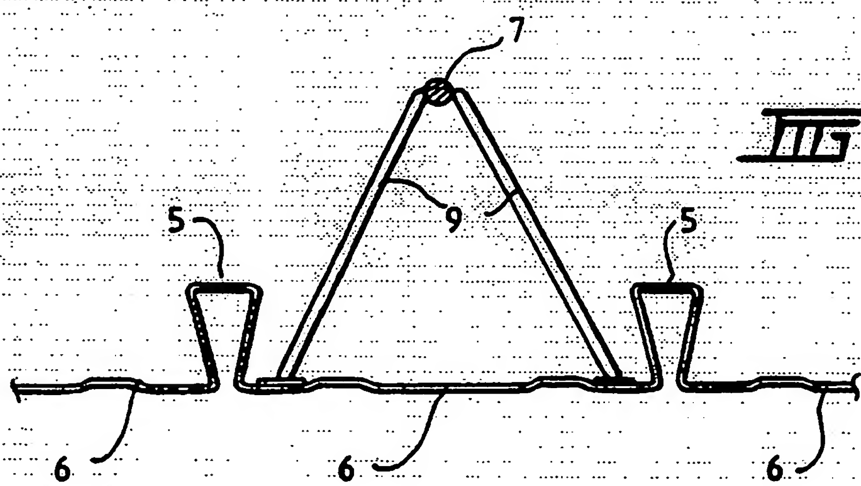


FIG. 3b.

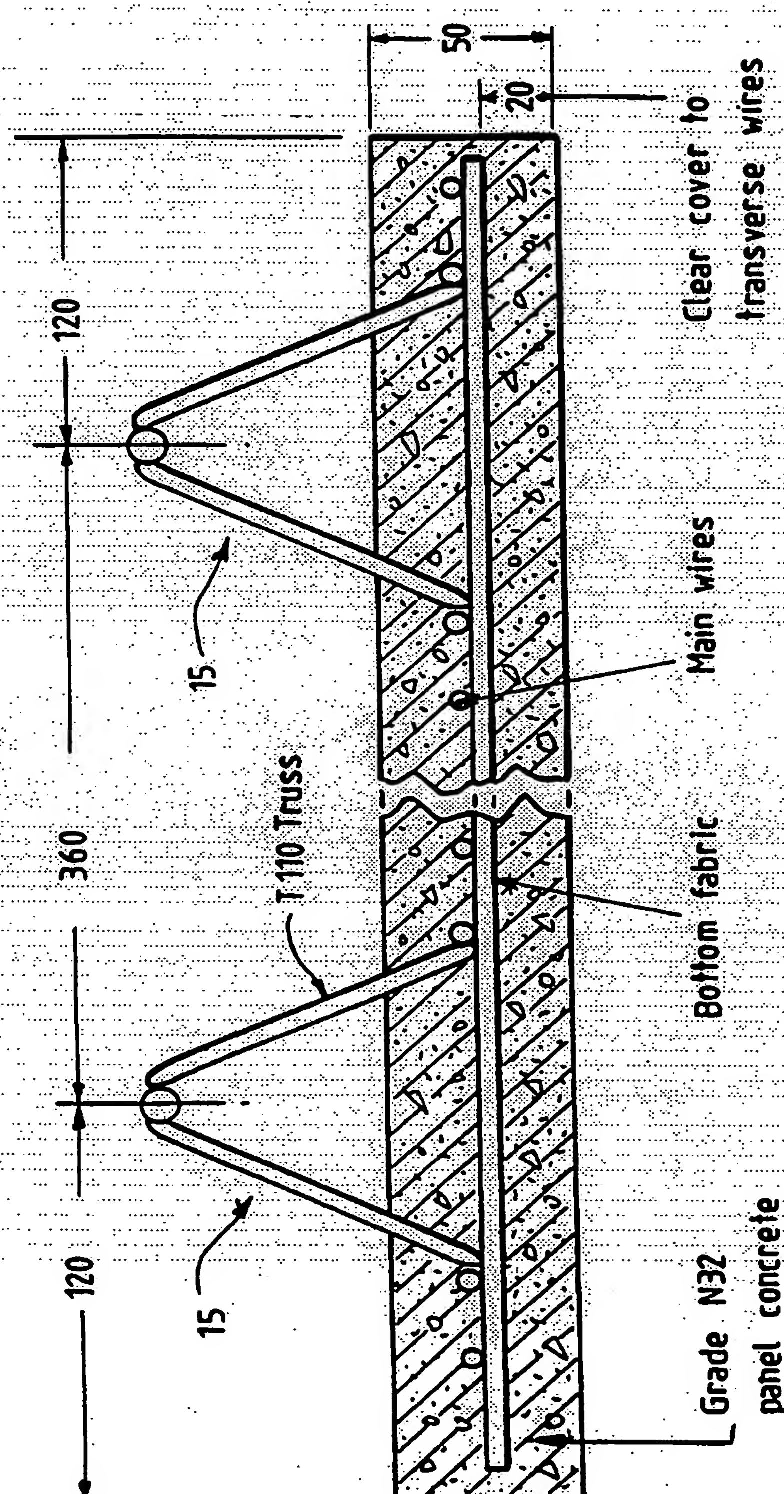
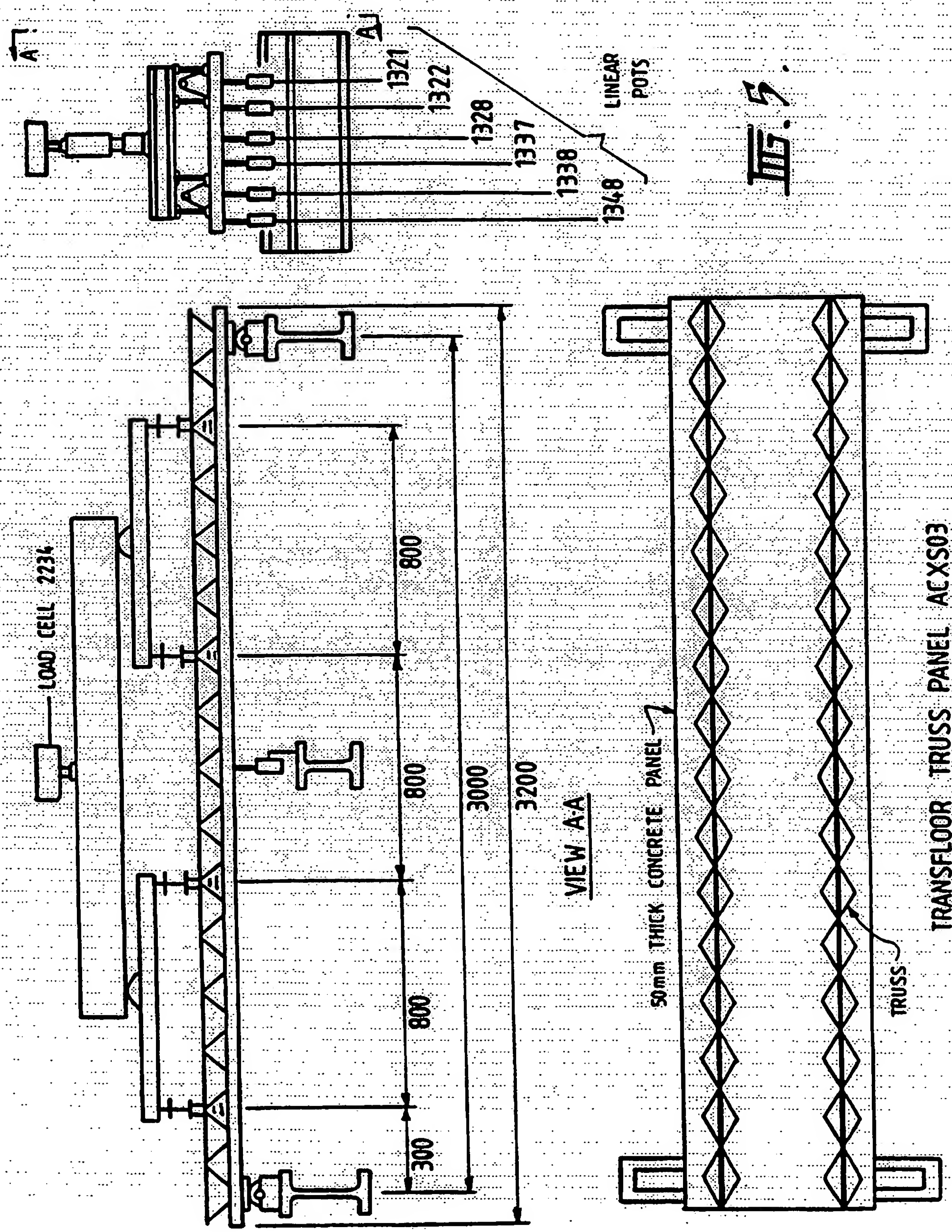

50
20
Clear cover to transverse wires
120
Main wires
15
T110 Truss
360
Bottom fabric
120
15
Grade N32 panel concrete

Fig. 4.


A
A
1321
1322
1328
1337
1338
1348
LINEAR
POTS
FIG. 5
LOAD CELL 2234
800
800
800
300
3000
3200
VIEW A-A
50mm THICK CONCRETE PANEL
TRUSS
TRANSFLOOR TRUSS PANEL ACXS03

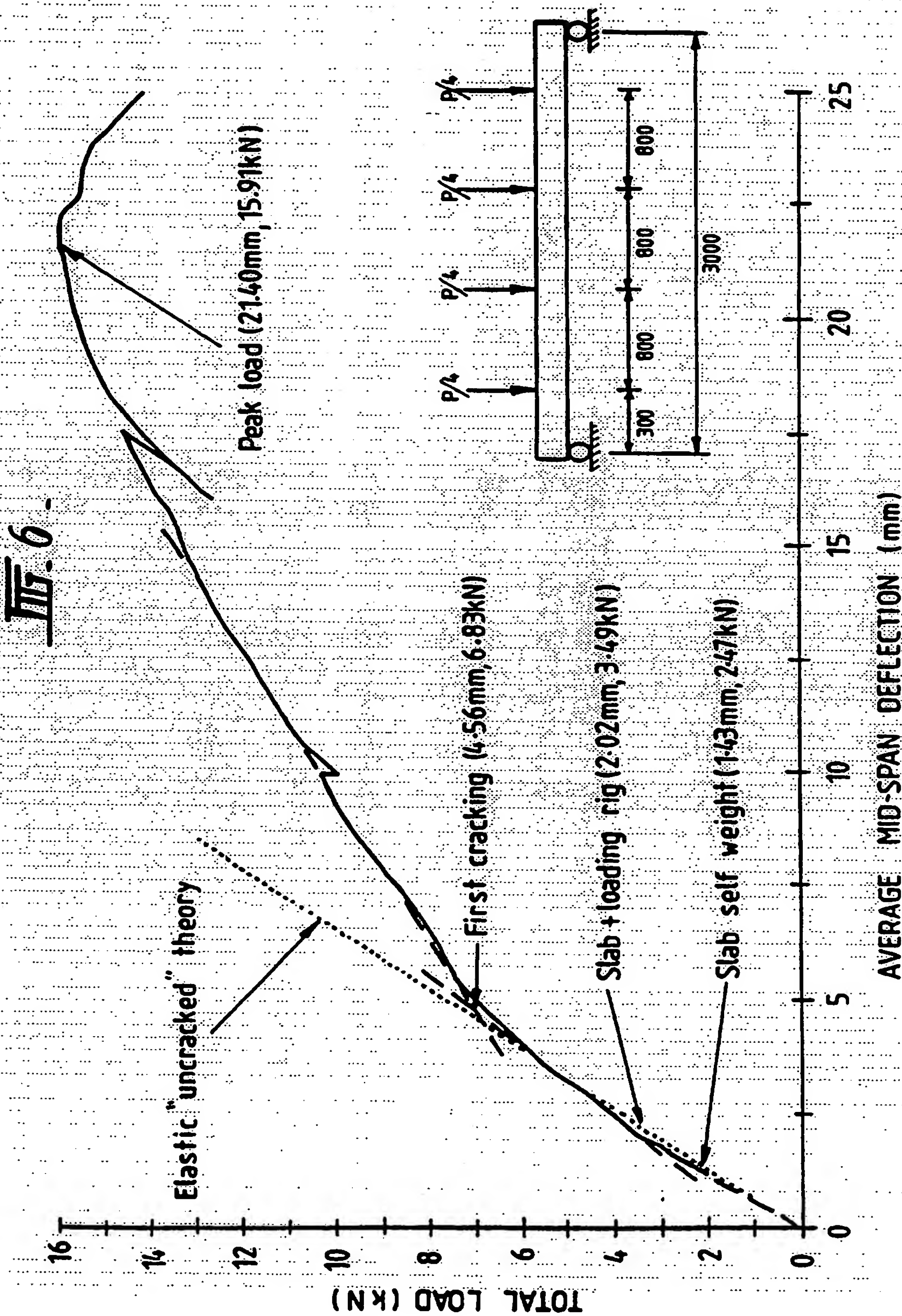

Peak load (21.40mm, 15.91kN)
Elastic "uncracked" theory
First cracking (4.56mm, 6.83kN)
Slab + loading rig (2.02mm, 3.49kN)
Slab self weight (1.43mm, 2.47kN)
P/4
P/4
P/4
P/4
800
800
800
300
3000
TOTAL LOAD (kN)
AVERAGE MID-SPAN DEFLECTION (mm)
0
2
4
6
8
10
12
14
16
0
5
10
15
20
25

FIG. 6

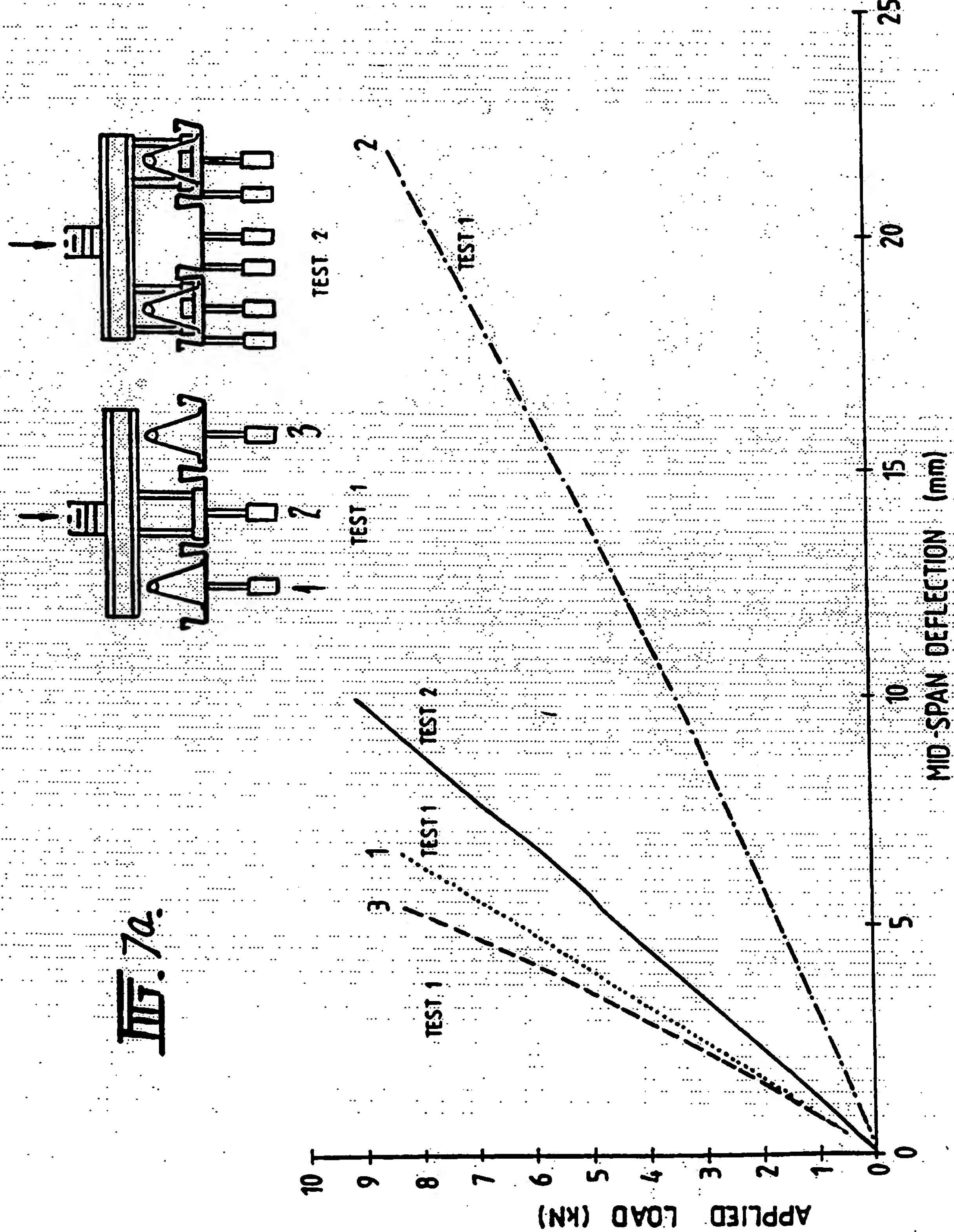

TEST 2
TEST 1
1
2
3
TEST 1
TEST 2
TEST 1
TEST 1
APPLIED LOAD (kN)
0 1 2 3 4 5 6 7 8 9 10
MID-SPAN DEFLECTION (mm)
0 5 10 15 20 25

Fig. 7a.

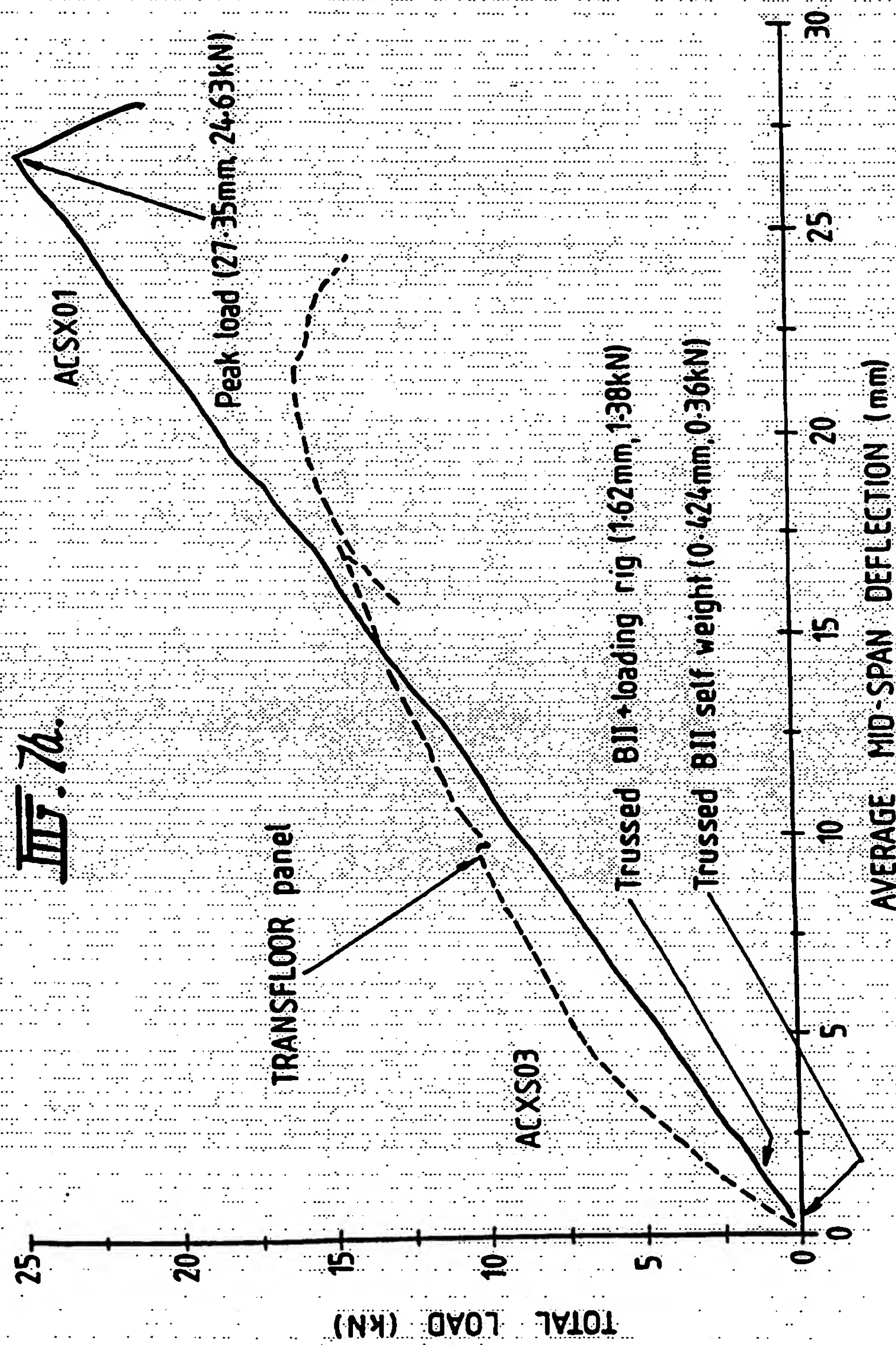

Peak load (27.35mm, 24.63kN)
ACSX01
ACXS03
TRANSFLOOR panel
Trussed BII + loading rig (1.62mm, 1.38kN)
Trussed BII self weight (0.424mm, 0.36kN)
AVERAGE MID-SPAN DEFLECTION (mm)
TOTAL LOAD (kN)
0
5
10
15
20
25
30

Fig. 7a.

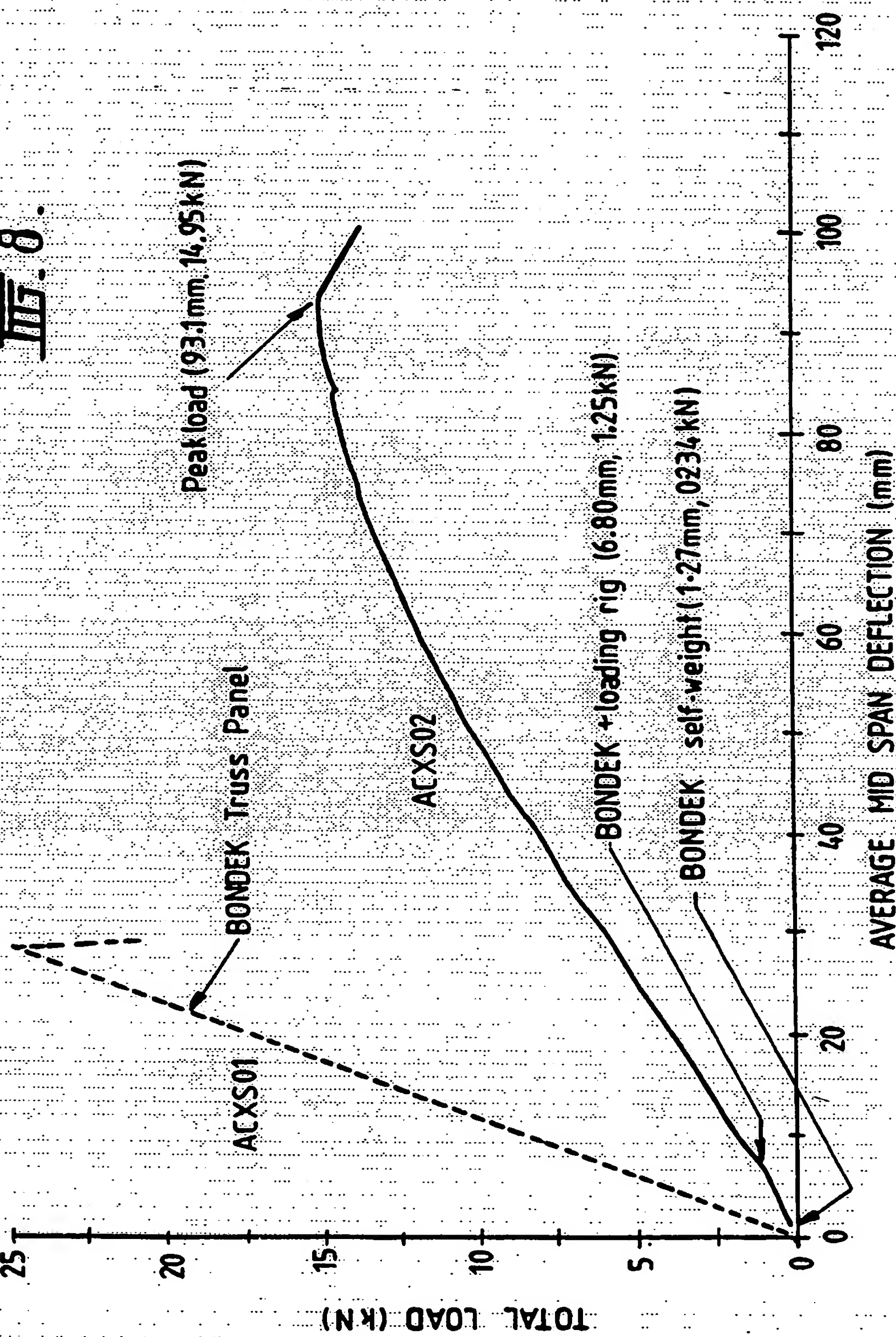

Peakload (93.1mm, 14.95kN)
BONDEK Truss Panel
ACXS01
ACXS02
BONDEK + loading rig (6.80mm, 1.25kN)
BONDEK self-weight (1.27mm, 0.234kN)
TOTAL LOAD (kN)
AVERAGE MID SPAN DEFLECTION (mm)
0
5
10
15
20
25
0
20
40
60
80
100
120

Fig. 8.

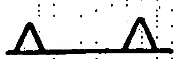
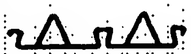
CASE	2m SPAN SIMPLY SUPPORTED Max. Vert. Deflection (mm)			4m SPAN SIMPLY SUPPORTED Max. Vertical Deflection(mm)			4m SPAN FIXED AT BOTH ENDS Max Vertical Deflection (mm)		
	RUN-1			RUN-2					
a 	-2.23	–	-1.36	-17.33	–	-16.48	–	–	–
	RUN-1			RUN-2					
b 	-8.33	–	-2.51	-38.13	–	-32.29	–	–	–
	RUN-1			RUN-2					
c 	-3.92	-3.86	-1.99	-30.80	-30.78	-26.62	–	–	–
	RUN-1			RUN-2			RUN-3		
d 	-4.58	-2.69	-1.91	-26.84	-24.51	-23.49	-9.74	-7.51	-6.59
	RUN-1			RUN-2			RUN-3		
e 	-4.17	-2.90	-2.91	-24.19	-23.00	-22.24	-8.38	-7.19	-6.62
	RUN-1			RUN-2			RUN-3		
f 	-4.68	-2.75	-1.92	-27.51	-25.01	-23.52	-10.13	-7.85	-6.60
	RUN-1			RUN-2					
g  60 60	-3.85	-3.79	-1.56	-26.96	-26.85	-18.89	–	–	–
	RUN-1			RUN-2					
h  100 60	-2.79	-2.42	-1.65	-22.23	-22.18	-19.19	–	–	–

FIG. 9.

INTERNATIONAL SEARCH REPORT

International Application No.
PCT/AU 96/00006

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[6]: E04B 5/40

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC E04B 5/36, 5/38, 5/40

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU : IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
Derwent

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 1339607 A (BASTGEN) 5 December 1973 See Figure 6 and Page 2 column 2 lines 100-108	1-9
X	GB 2060730 A (TINSLEY BUILDING PRODUCTS LTD) 7 May 1981 See Figures 1 and 2	1-9
X	Patent Abstracts of Japan, M-1161, page 69, JP, A, 3-151443 (KASIMA CORP) 26 June 1991. See Abstracts	1-9

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search
23 April 1996

Date of mailing of the international search report
29TH APRIL 1996

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C (Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Patent Abstracts of Japan, M-1289, Page 47, JP, A, 4-111835, (KAWA TETSU GALVANZING CO LTD) 13 April 1992	1-9
X	Patent Abstracts of Japan, M-1108, page 111, JP, A, 3-36347 (ROTSUTO ENG KK) 18 February 1991 See Abstract	1-9
X	Patent Abstracts of Japan, M-1344, page 85, JP, A, 4-222739 (HORY CORP) 12 August 1992 See Abstract	1-9
A	DE, 1060122 A (RHEINBAU GmbH) 25 June 1959	
A	GB 1589480 A (TINSLEY BUILDING PRODUCTS LIMITED) 13 May 1981	
A	Patent Abstracts of Japan, M-1717, page 80, JP, A, 6-248757 (CENTRAL GLASS CO LTD) 16 September 1994	

INTERNATIONAL SEARCH REPORT
Information on patent family members

International Application No.
PCT/AU 96/00006

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report	Patent Family Member
GB 1339607	
GB 2060730	
GB 1589480	

END OF ANNEX